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ABSTRACT

This article summarizes findings and recommendations about how to apply research on teaching and learning to classroom practice presented in "How People Learn: Bridging Research and Practice." Section 1 examines existing links between learning research and education practice. Section 2 highlights the ways that people learn, noting three findings that have implications for education practice: students come to the classroom with preconceptions about how the world works; to develop competence in an area of inquiry, students must master information in such a way that allows for the transformation of a set of facts into usable knowledge; and strategies can be taught that allow students to monitor their understanding and progress in problem solving. Section 3 discusses classroom environments that promote learning, advocating that schools embody four interrelated characteristics: maintain a learner-centered environment; pay attention to what is taught, why it is taught, and what competence or mastery looks like in order to provide a knowledge-centered classroom environment; conduct ongoing formative assessments designed to make students' thinking visible to both teachers and students; and pay attention to the context in which learning occurs. (Contains 18 references.) (SM)

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RESEARCH AND PRACTICE ON HOW PEOPLE LEARN
Pedagogical Inquiry and Praxis Number 1, March 2001
Informing the Development of High Academic Ability in Minority Students

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INFORMING THE DEVELOPMENT OF HIGH ACADEMIC ABILITY IN MINORITY STUDENTS

Research and Practice on How People Learn

Effective education strategies deliberately consider the various ways in which people learn and are evident in how well students draw on their existing knowledge and competencies as they master new skills and acquire new information. Given this dynamic, the development of effective strategies needs to be grounded in and informed by the research on teaching and learning.

A recent study, *How People Learn: Bridging Research and Practice*, edited by M. Suzanne Donovan, John D. Bransford, and James W. Pellegrino of the Committee on Learning Research and Educational Practice, the Commission on Behavioral, Social Sciences, and Education, and the National Research Council (published by National Academy Press, Washington, DC, 1999), demonstrates how to incorporate the insights from research on teaching and learning into classroom practice in order to increase student academic achievement. It also advocates an ongoing dialogue between researchers, teachers, administrators, curriculum specialists, and education policy makers.

The research on learning referenced in the study was presented in another National Research Council (NRC) report, *How People Learn: Brain, Mind, Experience, and School*, edited by John D. Bransford, Ann L. Brown, and Rodney R. Cocking of the Committee on Developments in the Science of Learning, National Research Council (published by National Academy Press, Washington, DC, 1999). This report reviewed recent findings about the many and complex processes involved in human learning, and presented new information from various branches of science that have considerably improved the understanding of what it means to acquire knowledge: from the neural processes that occur during learning to the influence of culture on what people perceive and absorb. The report also explored what and how educators teach, and how they have assessed what both children and adults learn. The implications of this research on the ways that people learn have both short- and long-term significance, especially in their application to all aspects of schooling, including the design of curricula, instruction, assessments, and learning environments.

This article summarizes findings and recommendations about how to apply the research on teaching and learning to classroom practice presented in *How People Learn: Bridging Research and Practice*.

Existing Links between Learning Research and Education Practice

The Committee on Learning Research and Educational Practice of the National Research Council first considered how research and practice are normally linked, and concluded that, except for the direct link between a small number of teachers involved in design experiments with researchers, the influence of research on practice is tenuous. Since knowledge about education

An Introductory Note to the First Issue

Pedagogical Inquiry and Praxis is a publication of the Program of Research on the Affirmative Development of Academic Ability, which is sponsored by the Institute for Urban and Minority Education at Teachers College, Columbia University, and the Minority High Achievement Program at the College Board. Through this publication, these institutions will provide information that has been digested and reflected upon. *Pedagogical Inquiry and Praxis* is designed to meet the needs of practitioners, policy makers, scholars of practice, and research scientists as they produce and utilize knowledge and techniques to improve the quality of academic achievement in diverse learners. It emphasizes the bi-directionality of knowledge production through practice and research, and issues associated with increasing the number of high academic achieving students who come from African American, Latina/o, and Native American families.

—Edmund W. Gordon

research is filtered through educational materials, preservice and inservice teacher education, public policy, the media and public opinion, the research on teaching and learning has not been communicated consistently and clearly, nor has this research been interpreted in ways that facilitate application to education practice.

The Ways That People Learn

The following three findings about how people learn are supported by solid research and have important implications for education practice:

(1) Students come to the classroom with preconceptions about how the world works.

If students' initial understanding is not engaged, they may fail to grasp new concepts and information presented in the classroom, or they may learn the material for purposes of test taking but revert to their preconceptions outside the classroom. Prior understanding in students at any level can impede their ability to learn contradictory ideas unless they are given the chance to explore the errors in their initial beliefs.

These facts about learning require that teachers: (1) draw out their students' existing knowledge through creation of classroom tasks and conditions that reveal students' thinking; (2) use it as the foundation for students to further understand the subject matter; and (3) use frequent formative assessments to make students' understandings apparent to themselves, their peers, and their teachers. These assessments are more useful in promoting learning with understanding than are tests measuring students' ability to repeat facts or demonstrate isolated skills. Schools of education can promote teachers' ability to work with students' preconceptions by helping teachers to: (1) identify predictable preconceptions that make mastery of subject matter challenging, (2) recognize unpredictable preconceptions, and (3) help students to build on their preconceptions by challenging them and replacing them when appropriate.

(2) To develop competence in an area of inquiry, students need a foundation of factual knowledge, an understanding of facts and ideas in the context of a conceptual framework, and the ability to organize them in ways that enable retrieval and application.

Research comparing the performance of novices and experts, in addition to research on learning and transfer, demonstrates that experts are "smart people" who also draw on a richly structured information base. But accessing factual information is not enough. The key to expertise is the mastery of concepts that allows for specialized learning and enables the transformation of a set of facts into usable knowledge. Experts use a conceptual framework to organize information into meaningful patterns that facilitates eventual retrieval for problem solving. And unlike the simple acquisition of factual knowledge, thoroughly understanding concepts facilitates the transfer of learning to new problems.

This finding suggests that in-depth coverage of fewer topics that enables learning of key concepts is preferable to the breadth of coverage of subject-related topics. Teachers, consequently, need a substantial knowledge base in a variety of subjects, familiarity with the process of inquiry, an understanding of the relationship between information and the concepts that help organize it in a discipline, and a grasp of the processes in students' conceptual development.

Thus, assessment tools that measure both deep conceptual understanding and factual knowledge and are aligned with the above approaches to teaching must be systematically developed.

(3) Strategies can be taught that allow students to monitor their understanding and progress in problem solving.

Research on the performance of experts reveals that they monitor their understanding carefully by: (1) making note of what additional information is needed; (2) deciding whether new information is consistent with what they already know; and (3) determining appropriate analogies, if any, so that they advance their understanding. This metacognitive approach functions as an internal dialogue as these individuals consider alternative solutions to problems and whether the one chosen will lead to the desired end. The strategies involved in such deliberate monitoring are part of a culture of inquiry, and can be successfully taught in the context of subject matter. In teaching these strategies, teachers model both the monitoring questions and observations and facilitate classroom discussion with the ultimate goal of fostering independent monitoring and learning in their students.

This finding requires that teachers integrate teaching and instruction in metacognitive skills into the curriculum in a variety of subject areas, and explicitly emphasize the internal inquiry process in order to enhance students' ability to learn independently.

Classroom Environments That Promote Learning

The value of these findings—also referred to as principles of learning—is in their application to the design of classroom environments that support student academic

achievement. Thus, *How People Learn: Bridging Research and Practice* advocates that schools embody the following interrelated characteristics:

(1) Maintain a learner-centered environment.

In schools that are learner centered, teachers pay close attention to the knowledge, skills, and attitudes that students bring into the classroom. This strategy focuses on integrating students' preconceptions about subject matter while it simultaneously promotes a better understanding of students. For example, teachers should be aware that:

- Cultural differences can affect students' comfort level in working collaboratively instead of individually. Differences are also reflected in the background knowledge that students bring to a new learning situation (Moll, Tapia, & Whitmore, 1993).
- Students' conceptions of what it means to be intelligent can affect their performance. Students who think that intelligence is a fixed entity are more likely to be performance oriented as opposed to learning oriented; they want to look good rather than risk making mistakes while learning. These students are more likely to give up when tasks become difficult. In contrast, students who think that intelligence is malleable are more willing to struggle with challenging tasks and are more comfortable with risk (Dweck, 1989; Dweck & Legget, 1988).

In addition, teachers in learner-centered classrooms are attentive to each student's individual progress and develop appropriate tasks which further facilitate deeper understanding of the material. For instance, they present students with challenging material that they can manage; that is, the problems are demanding enough to maintain engagement, but not so difficult as to lead to discouragement. This approach demonstrates teachers' understanding of their students' knowledge, skill levels, and interests (Duckworth, 1987).

(2) Pay attention to what is taught (i.e., subject matter), why it is taught (to enable understanding and eventual application), and what competence or mastery looks like, in order to provide a knowledge-centered classroom environment.

Expertise requires well-organized knowledge that supports understanding. Learning with understanding is important for the development of expertise because it makes new learning easier (i.e., it supports the transfer of knowledge to different situations). Learning with understanding is also harder and more time-consuming than simply memorizing. Many curricula fail to support learning with understanding because they present an array of disconnected facts in a short period of time. Similarly, tests often reinforce memorizing rather than understanding. A knowledge-centered environment, however, provides the tools for in-depth study and assesses students' understanding rather than their knowledge of disconnected facts. Furthermore, it incorporates the teaching of metacognitive strategies that facilitate future learning.

While students' interest or engagement in a task is important, it does not guarantee that students will acquire the various types of knowledge that will support new learning. Knowledge-centered environments, therefore, consider other factors besides engagement as the primary index of successful teaching (Prawat, Remillard, Putnam, & Heaton, 1992). "These environments also recognize that there are important differences between tasks and projects that "encourage hands-on doing and those that encourage doing with understanding" (*How People Learn: Bridging Research and Practice*, 1999, p. 21). According to Greeno (1991), the knowledge-centered environment emphasizes the latter.

(3) Conduct ongoing formative assessments designed to make students' thinking visible to both teachers and students.

Formative assessments help both teachers and students monitor progress. Equally important, they permit teachers to: (1) grasp their students' preconceptions, (2) understand where each student is along the continuum from informal to formal thinking, and (3) design curriculum and instruction accordingly.

Another important characteristic of formative assessments is their learner-friendliness. Rather than requiring students to quickly memorize information for a quiz which will result in a grade that ranks them with respect to their classmates, these assessments provide students with opportunities to revise and improve their thinking (Vye et al., 1998), help them see their own progress over the course of weeks or months, and assist teachers in identifying potential problems in students' critical literacy and comprehension that may need to be remedied.

(4) Pay attention to the context (i.e, the community) in which learning takes place.

Since learning is influenced in fundamental ways by its context, promoting student achievement via their community requires the development of norms for the classroom, schools, and the outside world that both support and inform core learning values.

In some schools, the norms may require that students build their own information base; others may encourage academic risk taking and provide opportunities for students to make mistakes, obtain feedback, and revise their thinking. School norms must also support students' comfort in revealing their preconceptions about a subject,

their questions, and their progress toward understanding new conceptual constructs related to the subject.

Similarly, teachers must design classroom activities and help students to promote the kind of intellectual camaraderie and attitudes toward learning that build a sense of community. These activities may take the form of students solving problems together by building on each other's knowledge, asking questions to clarify explanations, and suggesting differing solutions (Brown & Campione, 1994). Relatedly, the research indicates that cooperation and argumentation in problem solving enhance cognitive development and are factors in promoting student achievement (Evans, 1989; Goldman, 1994; Habermas, 1990; Kuhn, 1991; Moshman, 1995a; 1995b; Newstead & Evans, 1995; Salmon & Zeitz, 1995; Youniss & Damon, 1992).

Lave & Wegner (1991) found that a community-centered approach also supports teachers' efforts to establish a community of learners among themselves. Such a community encourages questioning and can become a model for creating new ideas that builds on the contributions of individual members. Community membership can produce in teachers a sense of excitement and ownership of new ideas to apply to theory and practice which they can transfer to teaching and learning in their classroom.

Finally, community-centered schools develop new ways to link classroom learning to other aspects of students' lives. For example, they can secure parents' support for the school's core learning principles and work with them to provide learning experiences and supplementary education beyond the classroom, where in fact children spend most of their time.

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